

SECTION C — ($3 \times 10 = 30$ marks)

Answer any THREE questions.

16. Explain the local and particle rates of change in detail.
17. Derive the Bernoulli's equation.
18. Doublets of strengths μ_1, μ_2 are situated at points A_1, A_2 whose cartesian coordinates are $(0, 0, C_1)$, $(0, 0, C_2)$, their axes being directed towards and away from the origin respectively. Find the condition that there is no transport of fluid over the surface of the sphere $x^2 + y^2 + z^2 = C_1 C_2$.
19. A vortex of circulation $2\pi k$ is at rest at the point $z = na$ ($n > 1$) in the presence of a plane circular boundary $|z| = a$, around which there is a circulation $2\pi \lambda k$. Show that $\lambda = \frac{1}{n^2 - 1}$. Show that there are two stagnation points on the circular boundary $z = ae^{i\theta}$, symmetrically placed about the real axis in the quadrants nearest to the vortex, given by $\cos \theta = \frac{3n^2 - 1}{2n^3}$ and prove that θ is real.
20. Discuss the relations between stress and rate of strain.

NOVEMBER/DECEMBER 2025

GMA42/DMA42 — FLUID DYNAMICS



Time : Three hours

Maximum : 75 marks

SECTION A — ($10 \times 2 = 20$ marks)

Answer ALL the questions.

1. Define hydrodynamics.
2. Define a unit vortex tube.
3. Write the Euler's equation of motion.
4. State the Pascal's laws for static fluids.
5. Define a simple sink.
6. Define the strength of the source.
7. Define the stream function.
8. Define a line source.
9. Define the principle stresses.
10. Define the kinematic coefficient of viscosity.

SECTION B — (5 × 5 = 25 marks)

Answer ALL the questions.

11. (a) Explain the streamlines and pathlines.

Or

- (b) For a fluid moving in a fine tube of variable section A, prove from first principle that the equation of continuity is,
 $A \frac{\partial p}{\partial t} + \frac{\partial}{\partial s}(APV) = 0$ where v is the speed at a point P of the fluid and S the length of the tube up to P. What does this become for steady incompressible flow?

12. (a) Explain the venturi tube.

Or

- (b) A long pipe is of length l and has slowly tapering cross-section. It is inclined at angle α to the horizontal and water flows steadily through it from the upper to the lower end. The section at the upper end has twice the radius of the lower end. At the lower end, the water is delivered at atmospheric pressure. If the pressure at the upper end is twice atmospheric find the velocity of delivery.

13. (a) A three-dimensional doublet of strength μ whose axis is in the direction $\overline{ox}$ is distant a from the rigid plane $x = 0$ which is the sole boundary of liquid of density ρ , infinite in extent. Find the pressure at a point on the boundary distant r from the doublet given that the pressure at infinity is p_∞ . Show that the pressure on the plane is least at a distance $\frac{a\sqrt{5}}{2}$ from the doublet.

Or

- (b) Explain about the images in a rigid infinite plane.

14. (a) Discuss the flow for which $w = z^2$.

Or

- (b) Derive the Cauchy-Riemann equations.

15. (a) Explain the translational motion of fluid element.

Or

- (b) Discuss the stress components in a real fluid.